Conference on Culture and Adversary Modeling

Algorithmic Tools for Adversarial Games Dynamic Adversarial Gaming Algorithm (DAGA)

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Agenda

- **Dynamic Adversarial Gaming Algorithm (DAGA)**
- **Adversarial Gaming and the DAGA Innovation**
- **DAGA Architecture**
- **Adversary Structure**
- **Technical Objectives**
- **DAGA proof of concept**
- **Expanded Focus Area**

Adversarial Gaming

- **DAGA will expand adversarial gaming algorithms to support an agent-based dynamic adversarial environment**
  - **There has been significant research into gaming algorithms by the gaming industry**
    - **Gaming industry is interested in making the game fun**
    - **Realism is related to appearance as opposed to actual actions**

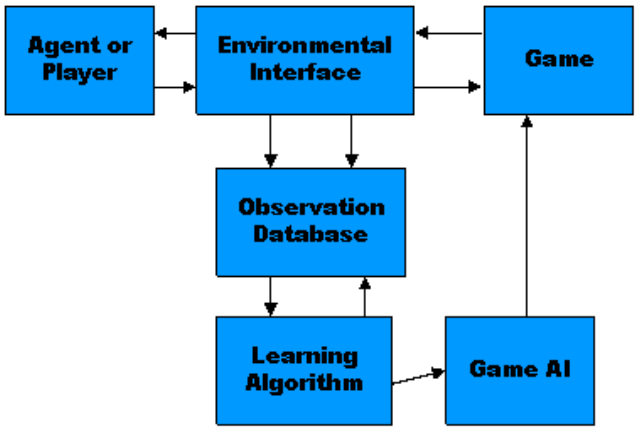
Adversarial Gaming

- **DAGA innovations to the adversarial gaming domain include:**
  - **Dynamic control of the game based on current observables.**
  - **Interaction among agents through an OWL-based Web Ontology**
  - **Agent split into sub-agents as the represented population diverges**
  - **Episodic learning to effect the group's behavior (based on experience over a period of time)**
- **Support of asymmetric adversarial games representing the interaction between blue and red forces and their effect on green forces**

Dynamic Adversarial Gaming Algorithm

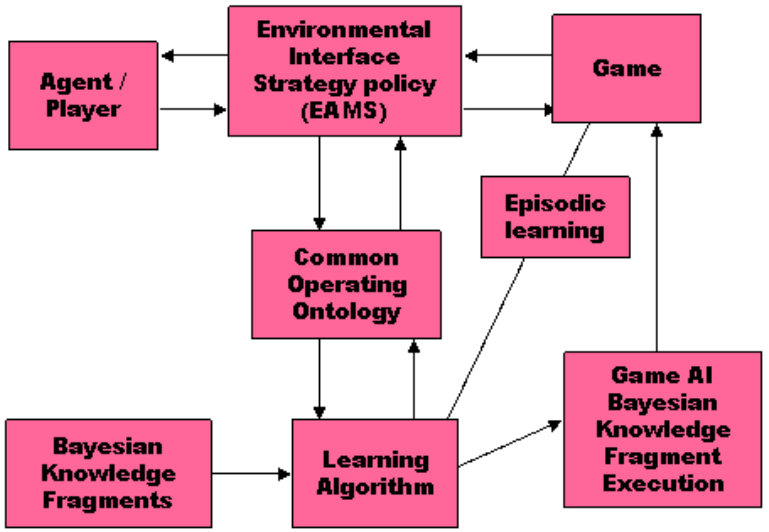
- **DAGA extends current adversarial gaming techniques**
  - **To support an agent framework that allows agents to understand the current state of the game**
  - **Communication through a common operating ontology**
  - **Ontology enables control active agents based on semantic relationships**
- **DAGA extends four proven adversarial modeling techniques**
  - **Existing political, economic, social and cultural models with soft factors will represent the Community Of Interest (COI) agent.**
  - **The Emergent Adversarial Modeling System (EAMS) will model adversary intent, soft factors and monitor observables**
  - **Bayesian Knowledge Fragments provide prediction over a wide range of potential actions**
  - **Episodic learning through instantiation of Bayesian Knowledge Fragments to adapt prior experience and its effect on the decision process.**

DAGA Architecture



Learning by Observation Design pattern

Is the Foundation for



Dynamic Adversary Gaming Algorithm Design pattern

Bayesian Knowledge Fragments

- **BKFs leverage the prediction strength of Bayesian-based algorithms**
- **Account for prior knowledge in the prediction**
- **BKFs avoid the computational cost and complexity of developing probability tables typically associated with Bayesian approaches**
- **Provides a prediction that**
  - **Is rapid and simple**
  - **Accounts for uncertainty**

Technical Objectives

- **Investigate Community Of Interest (COI) agents to represent people with similar interests**
  - **Current approaches view the adversary as a single entity**
    - **Works well for the strategic policy point of view**
    - **Provides limited insight into how a group reacts to specific actions**
  - **An agent framework to predict attitude formation and behavioral changes**
    - **In cultural contexts**
    - **Logical grouping of people with similar interests**
  - **The COI agent concept supports agent decomposition**

Technical Objectives continued …

- **Investigate incorporation of learning techniques in the agent framework**
  - **There has been significant research into gaming algorithms by the gaming industry**
    - **Gaming industry is interested in making the game fun**
    - **Realism is related to appearance as opposed to actual actions**
  - **For military applications the accuracy of the prediction is the measure of performance**
  - **DAGA will focus on the ability to develop algorithms that provide accurate predictions for a COI**
  - **Algorithms that accurately predict COI action can exploit two important characteristics**
    - **Gaming of multiple scenarios to determine actions that can influence the COI (to achieve a desired effect)**
    - **Prediction of how a COI will react to a specific action**

Technical Objectives continued …

- **An important aspects of group behavior is past experience of the group**
  - **Investigate ways to account for past experience**
  - **how past experience affects future actions**
- **Retention of the groups past experience based on multiple members can be a difficult maintenance problem**
- **Must be a separate view from the learning algorithms**
- **Must be straight forward to access and aggregate as the COI grows**
  - **Can instances of knowledge fragments be used to represent past experiences?**
  - **Can simple ways be developed to aggregate experience fragments to represent group experience?**
  - **Can past experience fragments play a role in determining the effect of leadership decapitation by removing the experiences of the disposed leader?**
  - **Impact on group dynamics?**

Expanded Focus Area

- **Initial focus on DOD and Security applications**
  - **Asymmetric Threat Detection**
  - **Mission Planning**
  - **Counter-terrorism**
- **Fundamental capability of DAGA is to predict individuals or group response to social, cultural, political and economic actions**
  - **Homeland Security / Intelligence**
    - **Potential acts of terrorist cells**

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Questions?

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